PATHOGEN MITIGATION UTILIZING UV TECHNOLOGY

APIC Sierra
2023 Annual Education Conference
November 2, 2023

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VP Innovation & Technology
Ultraviolet Devices, Inc

UVDI™
UV you can trust

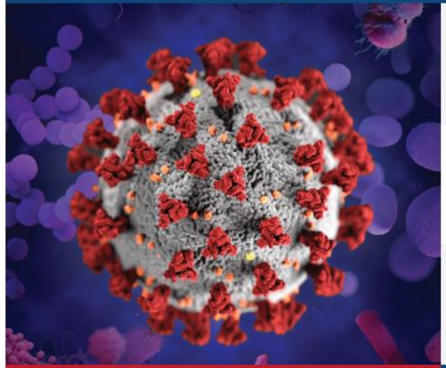
Introduction| Ongoing AR Threats and Challenges

Rising Antimicrobial Resistance and HAIs

COVID-19 CREATED A PERFECT STORM

The U.S. lost progress combating antimicrobial resistance in 2020

CDC



↑15% Antimicrobal-resistant infections and deaths increased in hospitals in 2020.

~80% Patients hospitalized with COVID-19 who received an antibiotic March-October 2020.

! Delayed or unavailable data, leading to resistant infections spreading undetected and untreated.

INVEST IN PREVENTION.

Setbacks to fighting antimicrobial resistance can and must be temporary.

Learn more: https://www.cdc.gov/drugresistance/covid19.html

Available data show an alarming increase in resistant infections starting during hospitalization, growing at least 15% from 2019 to 2020.

- Carbapenem-resistant *Acinetobacter* (↑78%)
- Antifungal-resistant *Candida auris* (↑60%)*
- Carbapenem-resistant Enterobacterales (↑35%)
- Antifungal-resistant *Candida* (↑26%)
- ESBL-producing Enterobacterales (↑32%)
- Vancomycin-resistant Enterococcus (↑14%)
- Multidrug-resistant *P. aeruginosa* (↑32%)
- Methicillin-resistant *Staphylococcus aureus* (↑13%)

**Candida auris* was not included in the hospital-onset rate calculation of 15%.

https://www.cdc.gov/drugresistance/national-estimates.html

The New York Times

With All Eyes on Covid-19, Drug-Resistant Infections Crept In

The spread of other dangerous germs is surging — a result, in part, of the chaotic response to the pandemic.

...cting a room where a Covid... germs spread. Shannon Stapl...

Contents lists available at ScienceDirect

ELSEVIER

American Journal of Infection Control

journal homepage: www.ajicjournal.org

AJIC American Journal of Infection Control

Commentary

Impact of SARS-CoV-2 on hospital acquired infection rates in the United States: Predictions and early results

Kathleen M. McM...

Terri Rebmann P...

[a] Christian Hospital and Nort...

[b] Mount Sinai Morningside, N...

[c] St. Louis University, St. Louis...

Morbidity and Mortality Weekly Report

***Candida auris* Outbreak in a COVID-19 Specialty Care Unit — Florida, July–August 2020**

Christopher Prestel, MD[1,2]; Erica Anderson, MPH[2]; Kaitlin Forsberg, MPH[3]; Meghan Lyman, MD[3]; Marie A. de Perio, MD[4,5]; David Kuhar, MD[1]; Kendra Edwards[6]; Maria Rivera, MPH[2]; Alicia Shugart, MA[1]; Maroya Walters, PhD[1]; Nychie Q. Dotson, PhD[2]

On January 8, 2021, this report was posted as an MMWR Early Release on the MMWR website (https://www.cdc.gov/mmwr).

In July 2020, the Florida Department of Health was alerted to three *Candida auris* bloodstream infections and one urinary tract infection in four patients with coronavirus disease 2019 (COVID-19) who received care in the same dedicated COVID-19 unit of an acute care hospital (hospital A). *C. auris* is a multidrug-resistant yeast that can cause invasive infection. Its ability to colonize patients asymptomatically and persist on surfaces has contributed to previous *C. auris* outbreaks in health care settings (*1–7*). Since the first *C. auris* case was identified in Florida in 2017, aggressive measures have been implemented to limit spread, including contact tracing and screening upon detection of a new case. Before the COVID-19 pandemic,

Among patients screened who had available medical records (20), two (10%) were admitted directly from a long-term care facility and eight (40%) died within 30 days of screening, but whether *C. auris* contributed to death is unknown (Table).

HCP in the COVID-19 unit were observed wearing multiple layers of gowns and gloves during care of COVID-19 patients. HCP donned eye protection, an N95 respirator, a cloth isolation gown, gloves, a bouffant cap, and shoe covers on entry to the COVID-19 unit; these were worn during the entire shift. A second, disposable isolation gown and pair of gloves were donned before entering individual patient rooms, then doffed and discarded upon exit. Alcohol-based hand sanitizer was used on gloved hands after doffing outer gloves. HCP removed all PPE and performed hand hygiene before exiting the unit.

Source: McMullen KM, Smith BA, Rebmann T. Impact of SARS-CoV-2 on hospital acquired infection rates in the United States: Predictions and early results. Am J Infect Control. 2020; https://www.nytimes.com/2021/01/27/health/covid-drug-resistant-infections.html

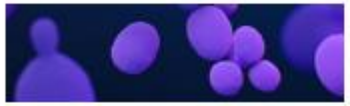
Prestel C, Anderson E, Forsberg K, Lyman M, de Perio MA, Kuhar D, Edwards K, Rivera M, Shugart A, Walters M, Dotson NQ. Candida auris Outbreak in a COVID-19 Specialty Care Unit - Florida, July-August 2020. MMWR Morb Mortal Wkly Rep. 2021 Jan 15;70(2):56-57.

Introduction| Ongoing AR Threats and Challenges

Urgent Threats

These germs are public health threats that require urgent and aggressive actio

CARBAPENEM-RESISTANT **_ACINETOBACTER_**



CANDIDA AURIS

CLOSTRIDIOIDES DIFFICILE

CARBAPENEM-RESISTANT **ENTEROBACTERIACEAE**

DRUG-RESISTANT **_NEISSERIA GONORRHOEAE_**

Serious Threats

These germs are public health threats that require prompt and sustained action:

DRUG-RESISTANT **_CAMPYLOBACTER_**

DRUG-RESISTANT **_CANDIDA_**

ESBL-PRODUCING **ENTEROBACTERIACEAE**

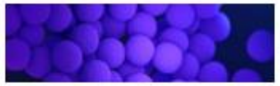
VANCOMYCIN-RESISTANT **_ENTEROCOCCI_**

MULTIDRUG-RESISTANT **_PSEUDOMONAS AERUGINOSA_**

DRUG-RESISTANT **NONTYPHOIDAL _SALMONELLA_**

DRUG-RESISTANT **_SALMONELLA_ SEROTYPE TYPHI**

DRUG-RESISTANT **_SHIGELLA_**



METHICILLIN-RESISTANT **_STAPHYLOCOCCUS AUREUS_**

DRUG-RESISTANT **_STREPTOCOCCUS PNEUMONIAE_**

DRUG-RESISTANT **TUBERCULOSIS**

Concerning Threats

These germs are public health threats that require careful monitoring and prevention action:

ERYTHROMYCIN-RESISTANT **GROUP A _STREPTOCOCCUS_**

CLINDAMYCIN-RESISTANT **GROUP B _STREPTOCOCCUS_**

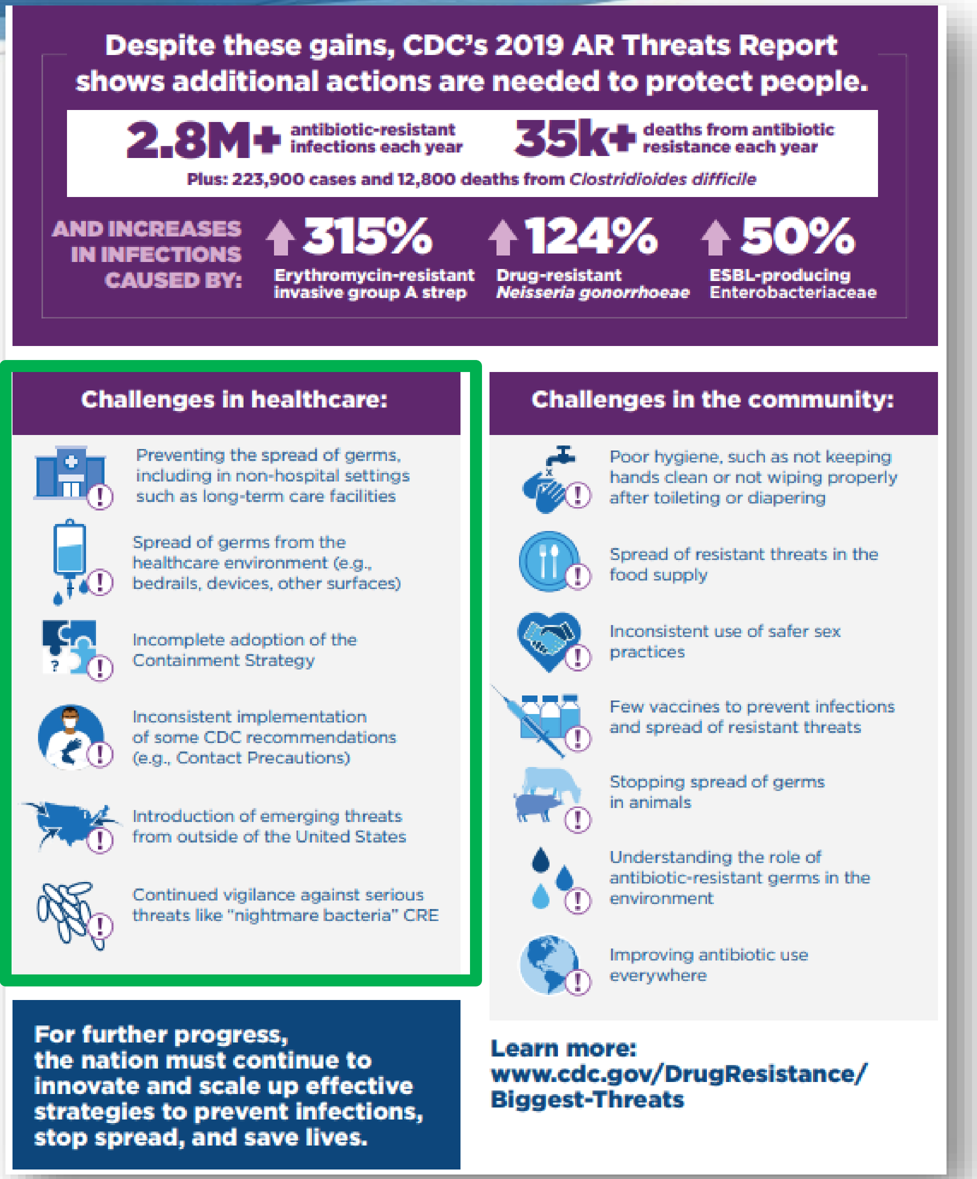
Source: https://www.cdc.gov/drugresistance/

Introduction| Ongoing AR Threats and Challenges

- Preventing the spread of germs

  - including non-hospital settings, LTC

- Spread of germs from the healthcare environment
  - (e.g. bedrails, devices, other surfaces)
- Incomplete adoption of the contaminant strategy
- Inconsistent implementation



Source: https://www.cdc.gov/drugresistance/

Learning Objectives

Describe	Ongoing challenges related to MDROs and Healthcare-associated Infections
Review	Control strategies to prevent surface and airborne transmission
Understand	Basics of UV-C technology and its applications for surface and air disinfection
Review	Key criteria to evaluate the effectiveness, operation and safety of whole room UV disinfection devices
Implement	Best practices for maximizing operational workflow and efficiency
Discuss	How UV-C technology can be applied to meet the new ASHRAE standard 241 for Control of Infectious aerosols

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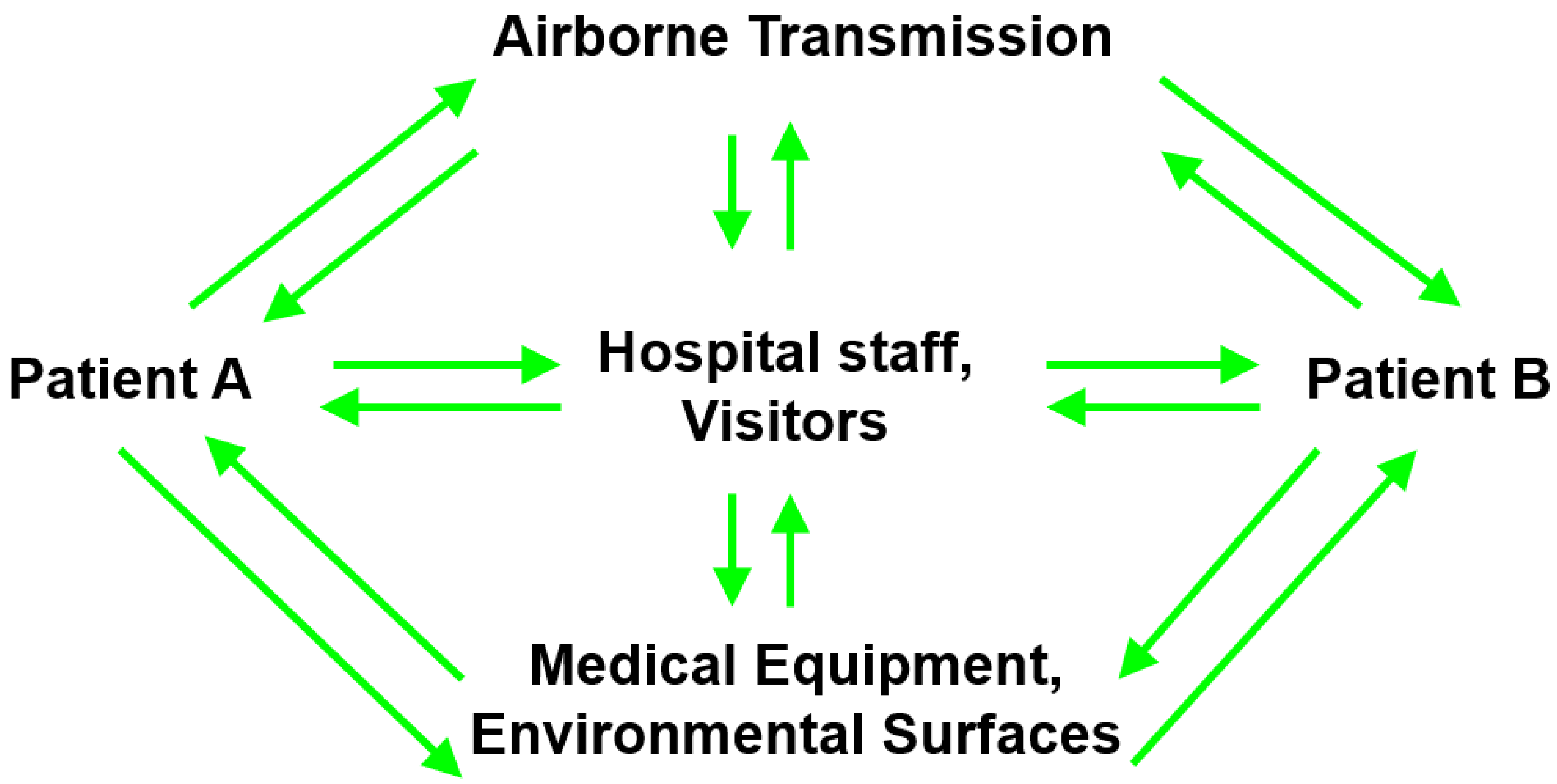
Environment as Vector for Transmission



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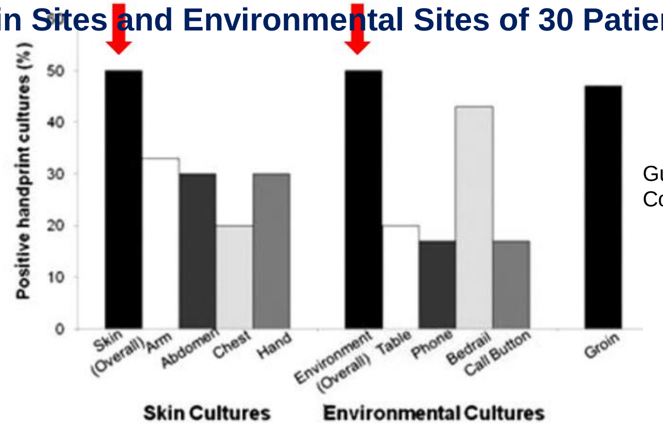
Environment as Vector for Transmission

- Contaminated surfaces increase cross-transmission

X Represents VRE culture positive site

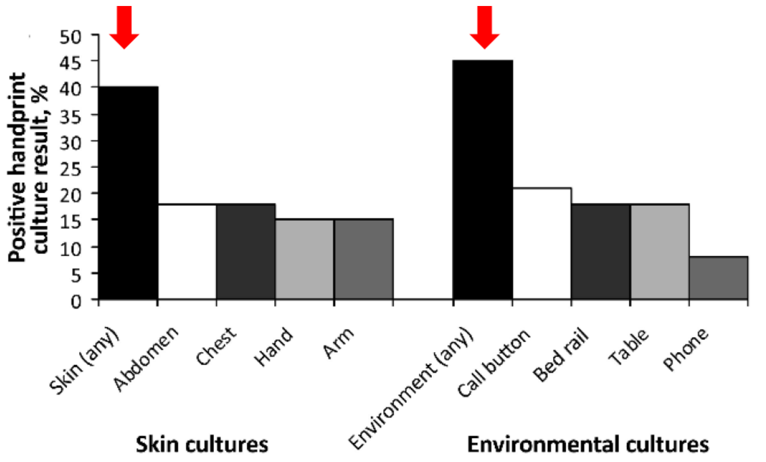
Abstract: The Risk of Hand and Glove Contamination after Contact with a VRE (+) Patient Environment. Hayden M, ICAAC, 2001, Chicago, IL.

Percentage of Positive Gloved Hand Imprint Cultures After Contact with Commonly Examined Skin Sites and Environmental Sites of 30 Patients with *Clostridium difficile*



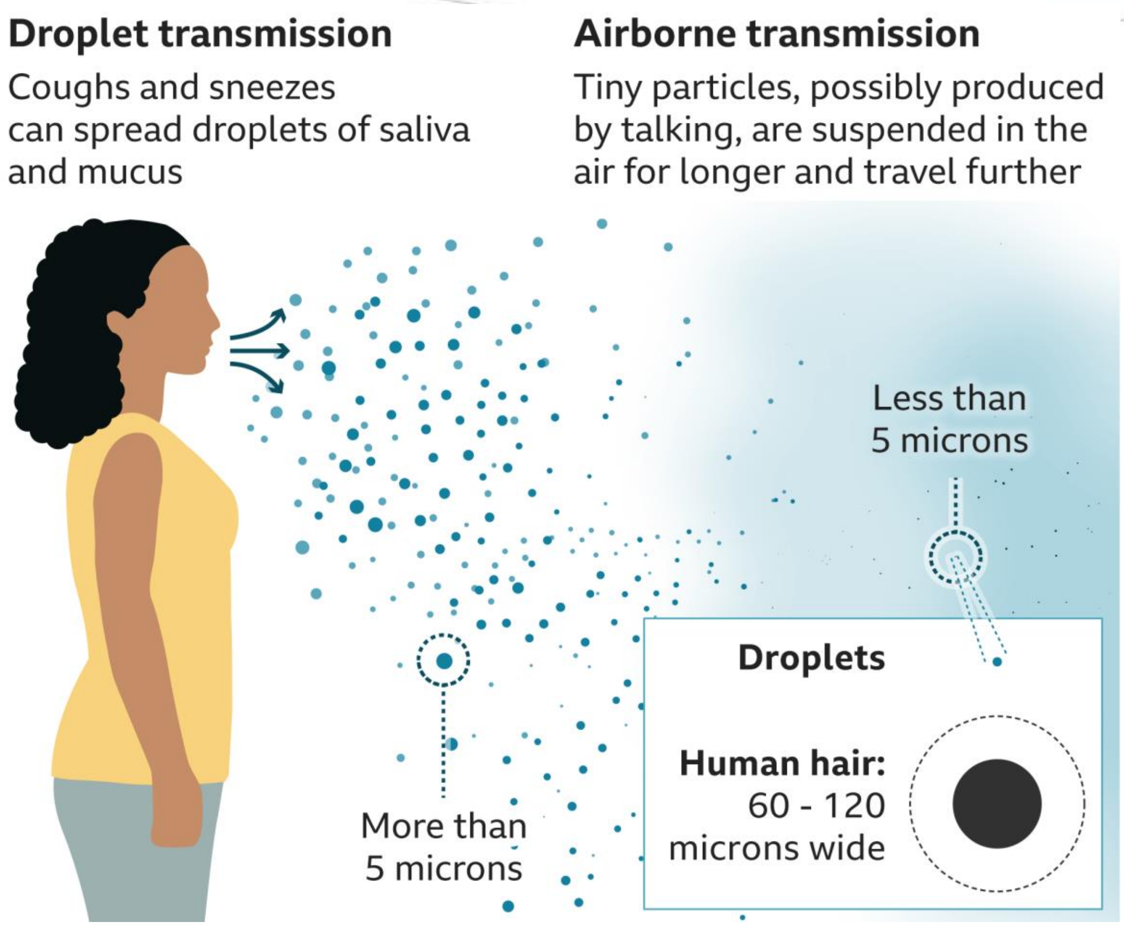
Guerrero DM et al. AmerJ Infect Control 2012;40:556

Frequency of Acquisition of MRSA on Gloved Hands After Contact with Skin and Environmental Surfaces



StiefelU et al. Infect Control Hosp. Epidemiol2011;32:185

Airborne & Droplet Transmission



Identification of SARS-CoV-2 RNA in Healthcare Heating, Ventilation, and Air Conditioning Units

Patrick F. Horve, Leslie Dietz, Mark Fretz, David A. Constant, Andrew Wilkes, John M. Townes, Robert G. Martindale, William B. Messer, Kevin G. Van Den Wymelenberg

doi: https://doi.org/10.1101/2020.06.26.20141085

Dismantling myths on the airborne transmission of severe acute respiratory syndrome coronavirus-2 (SARS-CoV-2)

2019 Novel Coronavirus (COVID-19) Pandemic: Built Environment Considerations To Reduce Transmission

Leslie Dietz,[a] Patrick F. Horve,[a] David A. Coil,[b] Mark Fretz,[a,c] Jonathan A. Eisen,[d,e,f] Kevin Van Den Wymelenberg[a,c]

Airborne transmission of SARS-CoV-2: The world should face the reality

Lidia Morawska[a,*], Junji Cao[b]

[a] International Laboratory for Air Quality and Health (ILAQH), School of Earth of Atmospheric Sciences, Queensland University of Technology, Brisbane, Queensland 4001, Australia

Limitations of Manual Cleaning

Candida auris Rapidly Recontaminates Surfaces Around Patients' Beds Despite Cleaning and Disinfection

May 4, 2022

Tori L. Whitacre

SHEA The Society for Healthcare Epidemiology of America

Candida auris environmental contamination is unlikely to be adequately controlled because re-contamination occurs within hours after disinfection.

Candida auris

Candida auris (*C auris*) recontaminates environmental surfaces within a patient's room within hours despite regular cleaning

AJIC American Journal of Infection Control

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Evaluation of Daily Environmental Cleaning and Disinfection Practices in Veterans Affairs Acute and Long-Term Care Facilities: A Mixed Methods Study

Results

Between December 2018 – May 2019 a total of sixty-two room observations (N= 3602 surfaces) were conducted. The average observed surface cleaning rate during daily cleaning in patient rooms was 33.6% for all environmental surfaces and 60.0% for high-touch surfaces (HTS). Higher cleaning rates were observed with bathroom surfaces (Odds Ratio OR = 3.23), HTSs (OR = 1.57), and reusable medical equipment (RME) (OR = 1.40). Lower cleaning rates were observed when cleaning semi-private rooms (OR = 0.71) and rooms in AC (OR = 0.56). In analysis stratified by patient presence (i.e., present, or absent) in the room during cleaning, patient absence was associated with higher cleaning rates for HTSs (OR = 1.71). In addition, the

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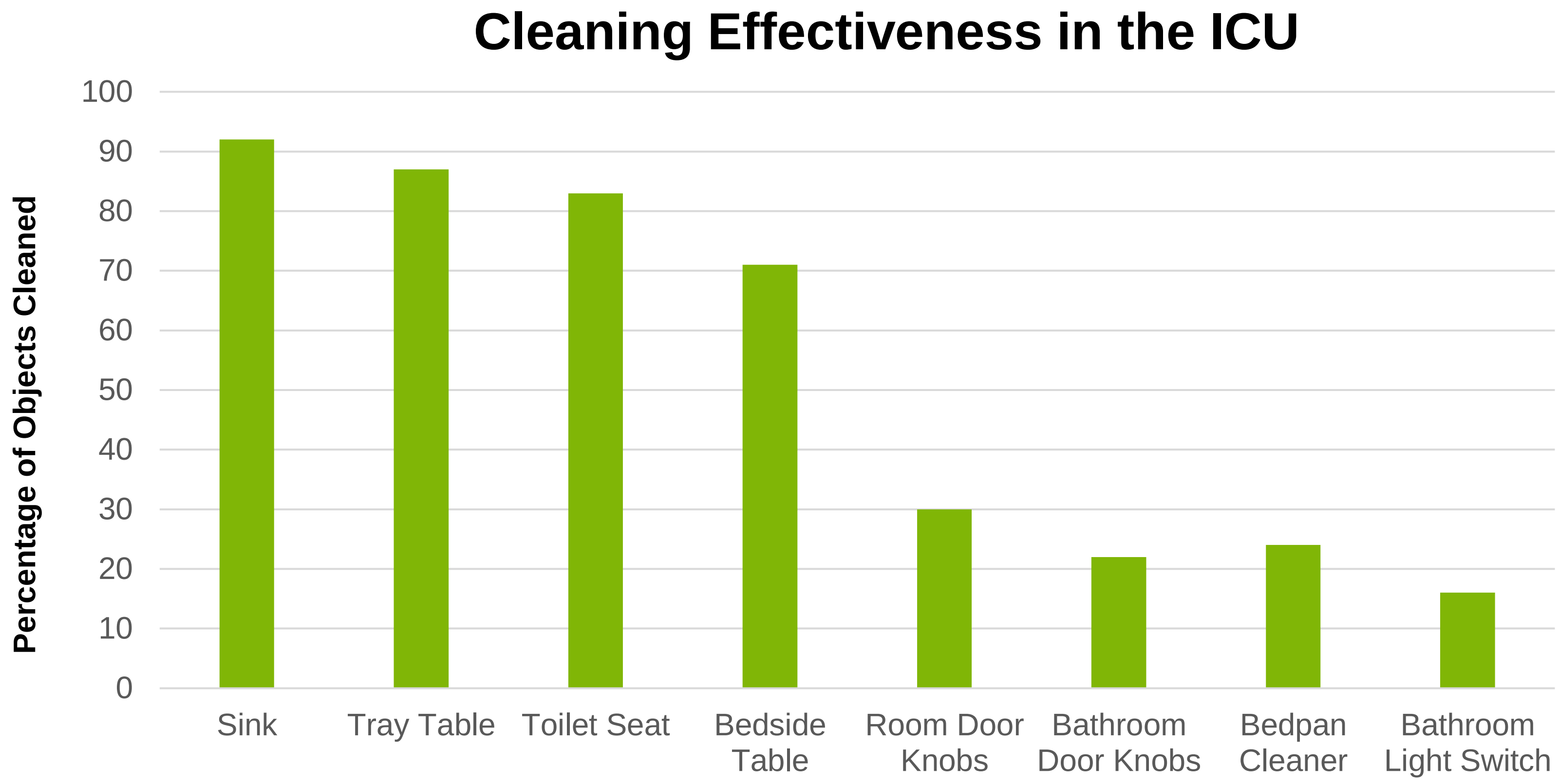
Limitations of Manual Cleaning

- **Carling JHI Study (2008):** less than 50% of hospital room surfaces are adequately cleaned and disinfected.



Carling PC, et al., *J Hosp Infect* 2008; 68: 39-44 Carling P. AJIC 2013;41:S20-S25

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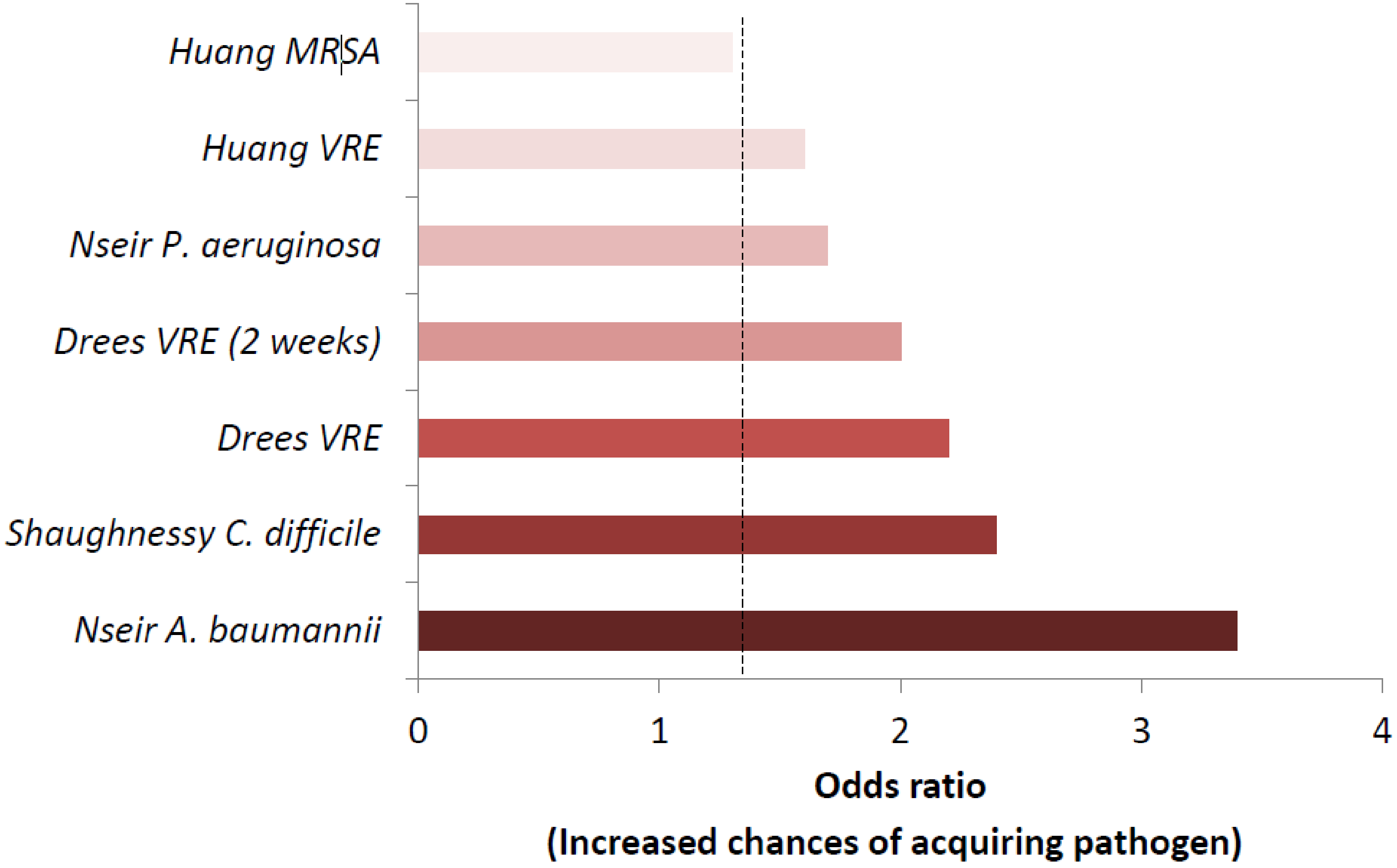
Increased Risk from Prior Room Occupant

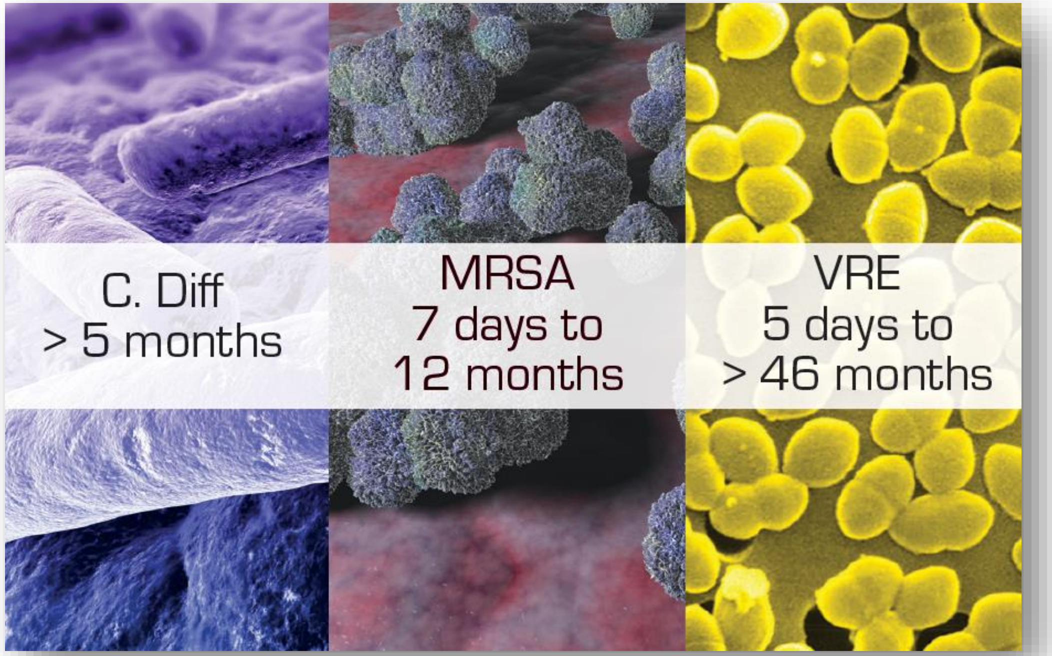
- Several studies have documented the risk that the prior room occupant poses to patients subsequently admitted to the room.



Otter *et al*. Am J Infect Control 2013;41:S6-S11

Survival of MDRO on Surfaces

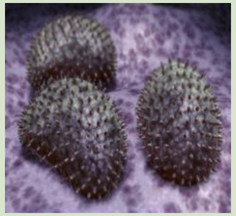
- Microorganisms survive on surfaces for prolonged amounts of time.



Organism	Surface Viability[1]
MRSA	2-9 weeks
C. Difficile spore	Days to 5 months
VRE	1-12 weeks
Acinetobacter	3-33 days
Norovirus	Hours to 12 days
CRKP	Several months
Carbapenem-resistant Gram-negative rods	3-20 days
SARS COV-2	28 days

[1]Hota B, et al. Clin Infect Dis 2004;39:1182-9, Kramer A, et al. BMC Infectious Diseases 2006;6:130;
Riddel et al. Virol J 17, 145 (2020), HospEpidemiol. 2014;35:445 Weber DJ et al. Infect Control Hosp. Epidemiol., 2015

Microbial Contaminants in Buildings

Bacteria	Fungi	Virus
		
Methylobacterium	*Aspergillus niger*	Coronavirus (SARS-CoV-2, SARS, MERS, H1N1)
Sphingomonas	*Aspergillus versicolor*	Influenza
Bacillus sp.	Penicillium	Tuberculosis
Klebsiella pneumoniae	Fusarium	Measles
Pseudomonas aeruginosa	Cladosporium	Smallpox
Flavobacterium	*Candida albicans*	
Enterobacter aerogenes	*Stachybotris chartarum*	
Salmonella thyphimurium	Alternaria	
Staphylococcus aureus	*Memnoniella*	
Legionella	Chaetonium	

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Targeted Implementation: IP Bundle

Active Surveillance and Testing (AST)

- Important aspect of vertical IC strategy; pathogen-specific
- Effective strategy in outbreak setting; AST in controlling the spread of organisms such as MRSA, *C. difficile*, CRE, SARS COV-2, *Candida auris*

Hand Hygiene

- Most important for both vertical and horizontal strategies
- Emphasize WHO guidelines for 5 moments of hand hygiene around patient environment

Universal Decolonization

- CHG bathing deployed in both horizontal and vertical strategy

Antibiotic Stewardship

- ASP largely deployed in context of horizonal strategy
- Can have broad spectrum efficacy or focus on specific MDRO, e.g. *C.difficile* spores

Environmental Cleaning

- High-touch surfaces in the patient environment and medical equipment may harbor organisms such as MRSA, VRE, Cdiff and other MDRO.

Surface Disinfection Approaches

Solution	Description	Attributes
core — **Chemical Disinfectants**	• Sodium Hypochlorite, Quaternary Ammonium, Hydrogen Peroxide, Hypochlorous Acid	• Varying effectiveness and contact times • Manual implementation • Material degradation can be an issue • Can be prone to human limitations
adjunct — **UV Disinfection**	• Rapid and reliable biocidal activity • Effective for both air and surfaces disinfection • Environmentally sustainable	• Can have broad spectrum efficacy; • No-touch technology • Excellent materials compatibility (less penetrating)
adjunct — **Hydrogen Peroxide Vapor (HPV)**	• H_2O_2 liquid dispensed by a misting or fogging device	• Broad spectrum efficacy; effective for porous and non-porous surfaces • Requires room preparation (e.g. seal vents, doors); potentially long cycle times and wait time prior to room re-entry

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Air Disinfection Approaches

Solution	Description	Attributes
core **Ventilation & Dilution**	• Purging with cleaner outside (or recirculated) air • Pressurization control • isolation rooms	• Holistic engineering approach for entire facility • Increase air changes per hour can help reduce infection
adjunct **Air Filtration**	• Filtration • MERV-13 or HEPA filters	• Need regular changeout • Increases energy • Difficult to retrofit/ upgrade for older facilities
adjunct **UV Disinfection**	• Rapid and reliable biocidal activity • Environmentally friendly	• Broad spectrum efficacy; • Effective for both air and surfaces disinfection

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UV-C Applications In Healthcare

Surface Disinfection

- Whole Room Disinfection
- Equipment/Small Object Disinfection

- Cooling Coil Disinfection inside Air Handling Unit

Air Disinfection

Centralized HVAC System

- Air Handling Units (AHUs)
- Duct Mounted (in-duct)

Local Area/Room Disinfection

- Upper Air UV
- Ceiling Mounted UV
- UV Room Air Purifiers

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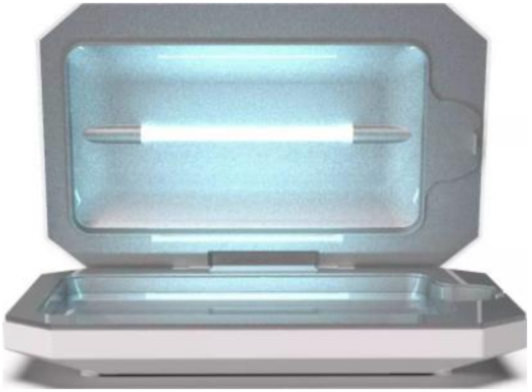
UV-C Surface Disinfection

Whole Room Disinfection

- Disinfect non-porous surfaces throughout a room
- Commonly used in Operating Rooms patient rooms, high-risk areas

Small Object Disinfection

Countertop



- Disinfect small devices: cell phones, laptops, stethoscopes
- Used near patient waiting areas, nurse stations

Targeted Disinfection

Portable/ Handheld

- Disinfect small devices: cell phones, laptops, stethoscopes
- Used near patient waiting areas, nurse stations

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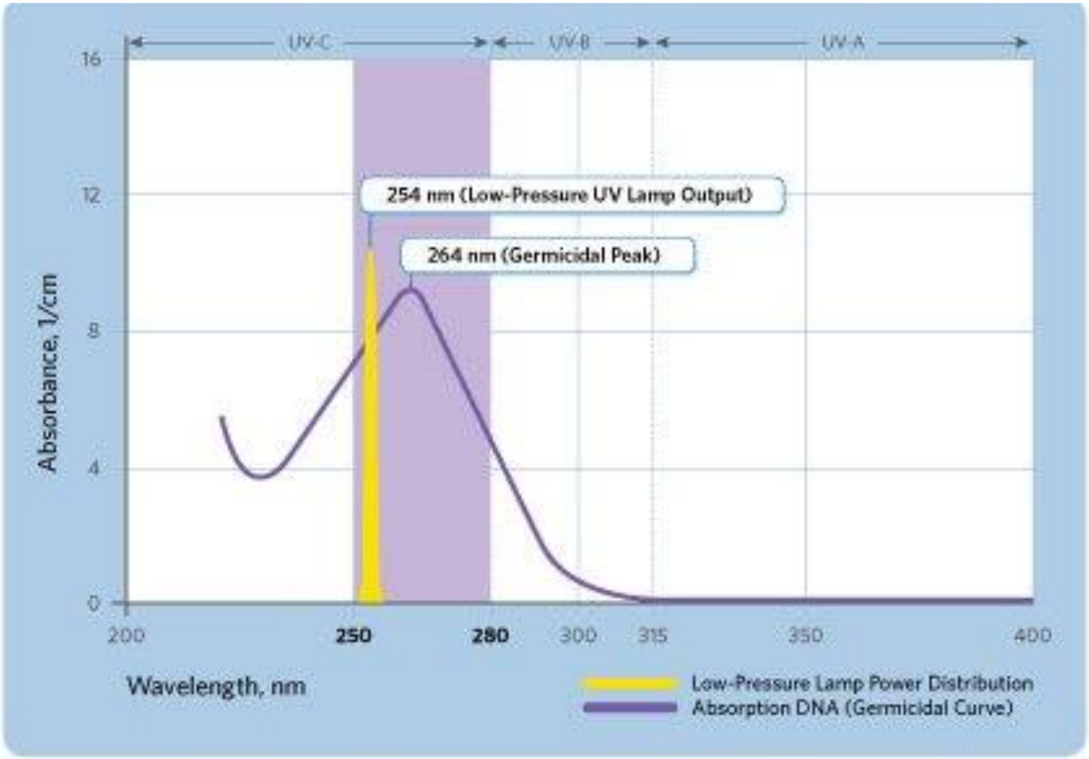
Basics of UV Disinfection

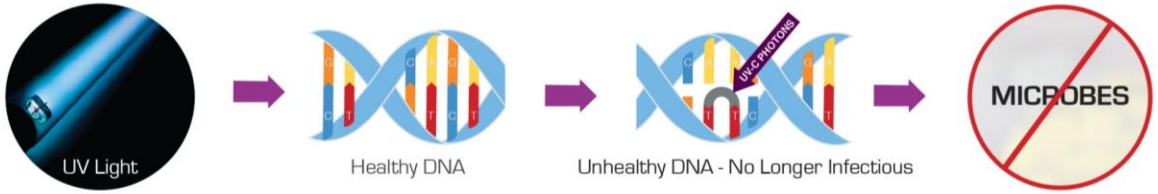
DNA UV Absorption Curve



Source: Ormeci, B., Ishida G., Linden K., IMPACT OF CHLORINE AND MONOCHLORAMINE ON ULTRAVIOLET LIGHT DISINFECTION

Most microorganisms exhibit peak UV absorption around 265 nm wavelength, which results in maximum damage via inactivation of cell DNA.

UV-C Damage Mechanism



Any organic based cell exposed to UV-C absorbs it at the molecular level and "deactivates" its DNA.

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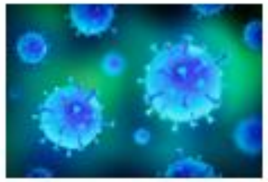
UV-C Effectiveness: Microorganism Susceptibility

- **UV-C dose required varies for different micro-organisms**
  - *C. difficile* requires a higher dose than *MRSA*
  - *Coronavirus (SARS-CoV-2)* requires smaller dose than *MRSA*

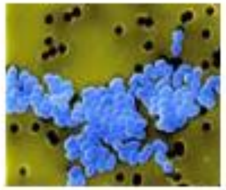
UV-C Dose Values for 99% Disinfection (2 Log Reduction)

MRSA
7,106 µW-sec/cm2

Clostridium difficile spore
38,500 µW-sec/cm2



Coronavirus
3,700 µW-sec/cm2 (3 log)



VRE
12,600 µW-sec/cm2

Influenza A
4,558 µW-sec/cm2

Aspergillus niger
330,000 µW-sec/cm2

Spaulding Hierarchy

Resistant → Susceptible	Level
Prions (Creutzfeldt-Jakob Disease)	Prion reprocessing
Bacterial spores (*Bacillus atrophaeus*)	Sterilization
Coccidia (*Cryptosporidium*)	Disinfection
Mycobacteria (*M. tuberculosis, M. terrae*)	*High*
Nonlipid or small viruses (polio, coxsackie)	
Fungi (*Aspergillus, Candida*)	*Intermediate*
Vegetative bacteria (*S. aureus, P. aeruginosa*)	*Low*
Lipid or medium-sized viruses (HIV, herpes, hepatitis B)	

Resistant
Susceptible

Modified from Russell and Favero.[13, 344]

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UV-C Effectiveness: Applied UV Dose

Total Applied Dosage = UV-C Intensity at target x Exposure Time

UV-C Intensity at target surface depends on:

How much UV-C light reaches the target surface?

UV-C is a line-of-sight technology

Reflectivity of room walls and surfaces

Exposure Time and Distance;

Lamp placement

What is the Total Intensity Output of UV-C device?

Lamp configuration, number and output

Height of lamps/device (distance off floor)

Other design aspects such as reflective components

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UV Whole Room Surface Disinfection

UV devices claiming whole room disinfection continue to proliferate!

- Various device design, shapes, sizes, lamp configuration are offered.
- The ability of UV devices to deliver an effective germicidal dose varies widely.
- UV device claims and features for efficacy, operational and safety also vary.

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Variations of Whole Room UV Disinfection Devices

Clinical

- Clinical lab studies: variation in study types and design (no industry standard)
- Testing parameters: Strain of microorganism, carrier type and size, prep of inoculum, type of soiling, inoculation of carrier, distance/orientation of carrier relative to device etc.
- Inconsistent dose assumptions used by different manufacturers

Operational and Safety

- Variation in treatment protocols
- Ease of set-up and operation
- Total room treatment time varies from 10 minutes to 50 minutes
- Total device output as a function of # lamps, height, intensity, configuration, reflectors etc.
- Device location / proximity to target surfaces
- Single placement versus multiple placements
- Automated cycle times based on room size mapping; reflected dose measurements, measured dose on surfaces

Key Device Selection Criteria: Performance Validation

Verify the device has independently proven evidence as support for efficacy:

Independent testing at real-world distances
Independent claims support for effectiveness against microorganisms at distances representative of whole room disinfection.

Independent testing at rapid inactivation times
Independent claims support for effectiveness against microorganisms at times that support fast room turnover.

Independent peer-reviewed published hospital studies
Demonstrating effectiveness in use.

Validation that whole room was properly disinfected
Verifying UV dose delivered to all target locations in the room.

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Key Device Selection Criteria: *Beyond Efficacy*

Workflow

User Friendly

Simple user interface

On-device and remote operation

Room Treatment time

Maneuverability

Safety

Regulatory Certifications

Motion sensors

Warning signage

Lamp protection

Remote operation

Data Analytics

Automated data capture and usage analytics

Real-time updates for device usage, rooms treated

On-demand reports

Device history tracking

Durability & Maintenance

Hospital grade durability and reliability

Quality Certifications

Device uptime

Easy to maintain and replace parts

Warranty

Sales and Service Support

Efficient Implementation | Best Practices

CLINICAL

- Evaluate UV devices with independently proven efficacy and scientific evidence for improved patient outcomes in clinical settings

The robustness of manufacturer efficacy data can be a huge time saver, eliminating legwork by you to 'piece together the puzzle'

OPERATIONAL

- Device staffing requirements – incorporating basic device operations, time/devices per room, rooms per day – to get started
- Manufacturer attributes – supply chain expertise and capabilities, UV experience, regulatory certification and Quality standards

FINANCIAL

- Return on Investment (ROI) incorporating positive value of improved patient outcomes less the financial and staffing costs of a UV program
- Includes device pricing, payment programs such as financing and leasing

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Leverage Manufacturer data and support to build a case for UV adoption

Efficient Implementation | Best Practices

	Getting Started	Initial Implementation	Expanding Efficiently	Manufacturer Resources
Key activities	▪ Making the case to implement UV disinfection	▪ Implementing UV room disinfection in targeted areas	▪ Efficiently broaden UV use to new areas	▪ Program resources that aid efficient UV implementation
Resources	▪ Manufacturer clinical, operational and financial support	▪ Basic device operation and features ▪ Device serviceability ▪ Manufacturer training and support	▪ Advanced device features to aid expansion ▪ Fleet management software and analytics ▪ Cross-functional collaboration	▪ Device servicing and care ▪ Marketing and PR support

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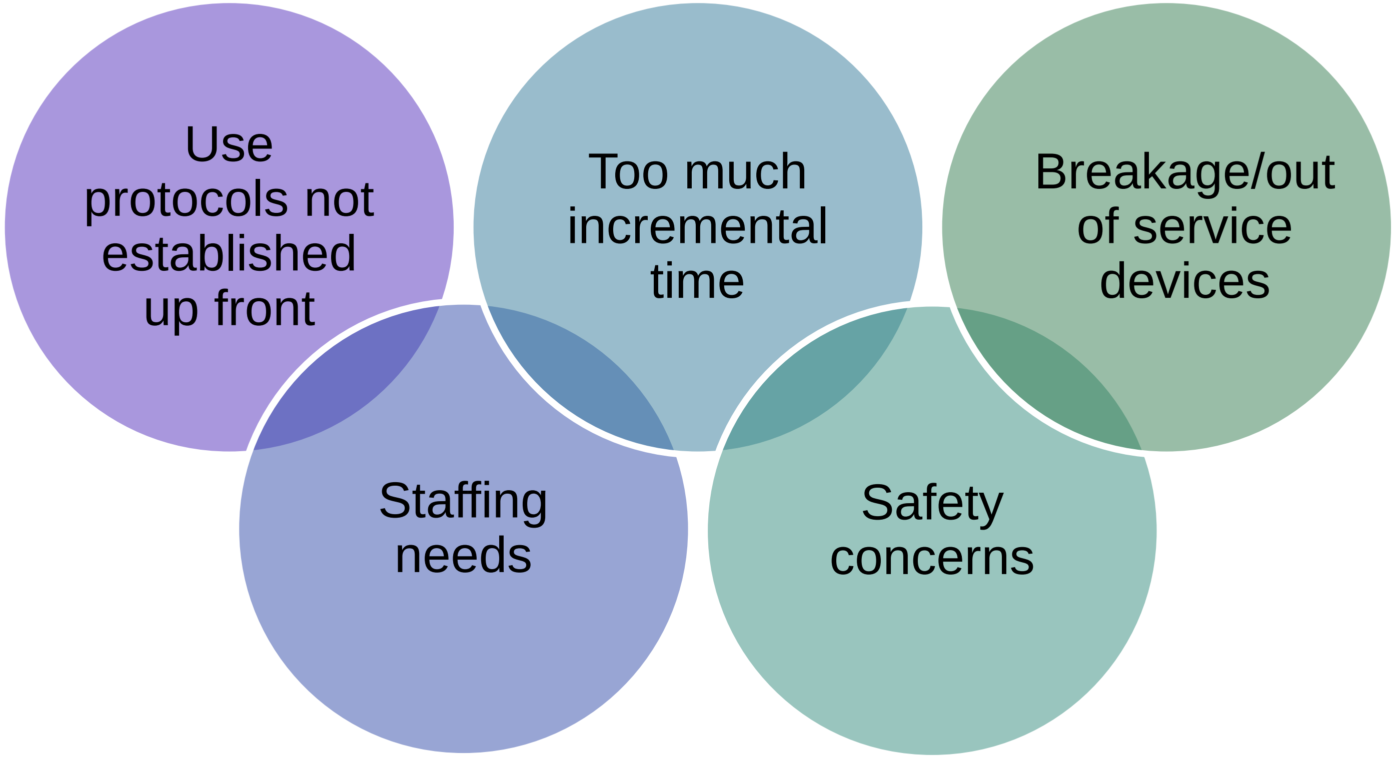
Targeted Implementation: UV Room Disinfection Checklist

Scope	Prior to Implementation	During Implementation
Clinical	❑ Review independent lab testing vs. targeted pathogen(s) ❑ Review independent published studies vs. targeted pathogen(s) ❑ Review clinical evidence in targeted use sites	❑ Technology to confirm UV dose delivered to surface ❑ Technology to confirm device cycle times and protocols for specific locations
Operational	❑ Identify a program champion to lead training and implementation ❑ Verify device can disinfect targeted sites during shift schedule. ❑ Labor needs: ensure device operation is simple and user-friendly. ❑ Review device safety features ❑ Review Manufacturer pedigree and Quality/Manufacturing	❑ Technology to verify compliant use in practice. ❑ Ability to save/access room treatment settings between users to drive consistency and standardization. ❑ Cloud-based analytics to record and report usage. ❑ Device health reporting to ensure continuous uptime.
Financial	❑ Device cost, payment options and payment plans ❑ Verify if manufacturer requires annual re-certification and/or Service contracts ❑ Plan for replacement parts based on manufacturer claims ❑ Plan for device use life based on manufacturer's Quality controls and device durability	❑ Review Total Cost of Ownership over time based on ongoing replacement parts and service spending; device lifespan and labor needs. ❑ Factor in potential cost savings due to Patient Outcomes to output estimated Return on Investment

Efficient Implementation | Best Practices

Common workflow challenges include:



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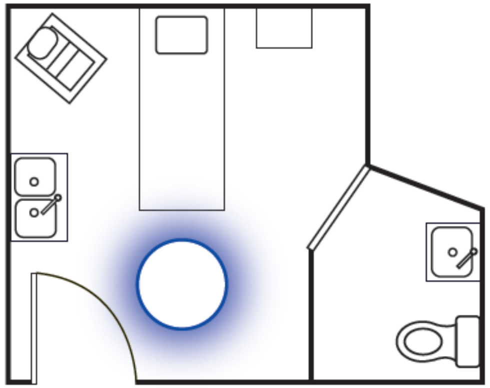
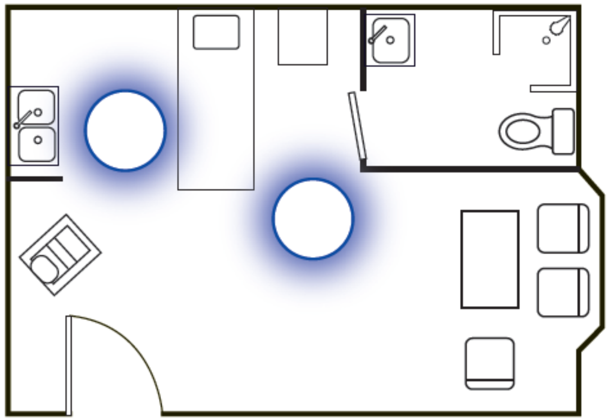
Implementation: Best Practices

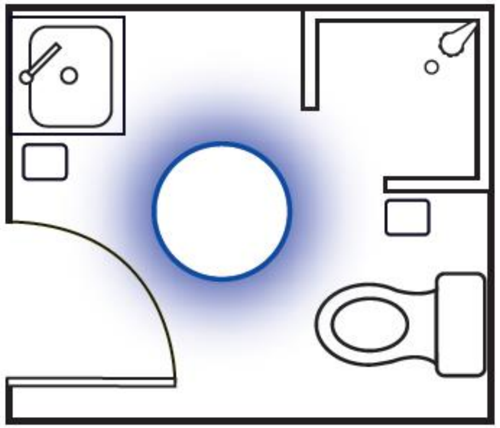
- Every room is different: ensure technology to confirm – and train - room disinfection protocols (UV device placement, cycle treatment times)

Patient Rooms:
- Confirm device placement(s)
- Confirm room treatment time (esp. sporicidal)

Bathrooms:
- Can device fit?
- Confirm sporicidal treatment time



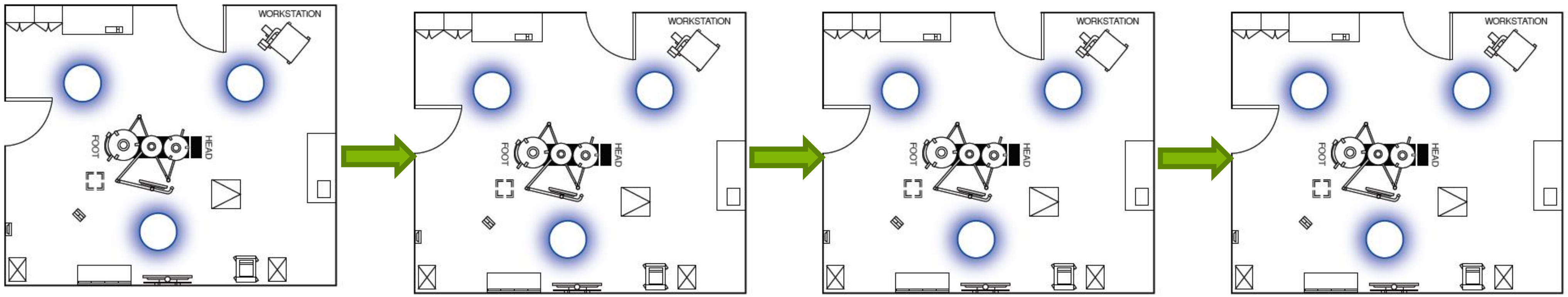




Targeted Implementation: Workflow Integration

- Assess whether UV room disinfection device can rapidly disinfect entire units and still fit into – versus disrupt – your workflow:

Operating Room #1: **Operating Room #2:** **Operating Room #3:** **Operating Room #4:**



Room-to-room + setup **Room-to-room + setup** **Room-to-room + setup**

Implementation: Best Practices

Operational best practices to integrate UV room disinfection into a comprehensive bundle

- **Identify a UV room disinfection program champion**
- **Interdisciplinary team: effective collaboration** between UV device manufacturer, Infection Control, Environmental Services, OR leadership
- **Integrate with broader workflow;** standardized UV use across room types and users. Include in annual competency and validation
- **Use device analytics to maximize device uptime.** Measure device requirements for hospital-wide use and impact

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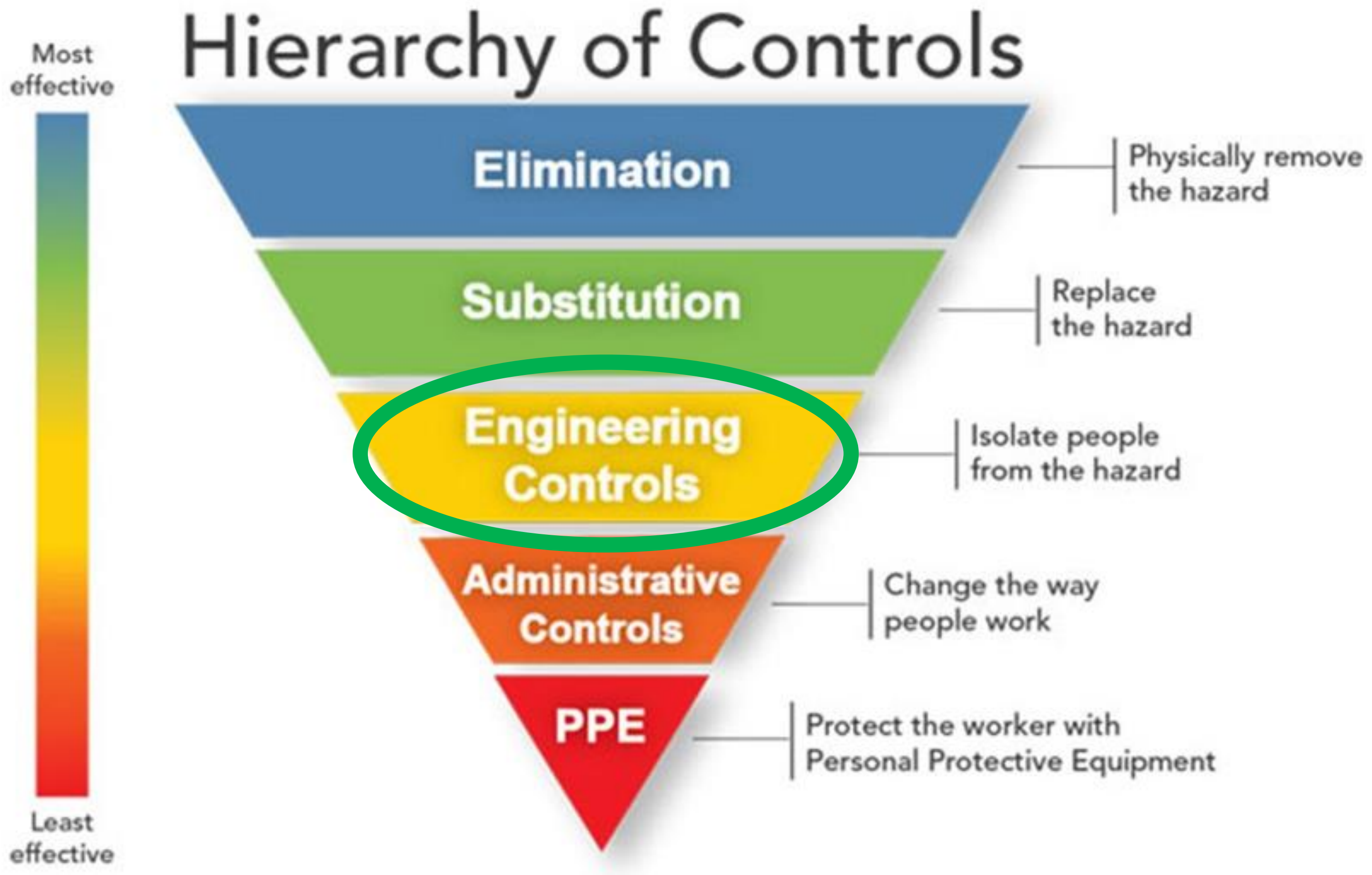
Strategies to Mitigate Airborne Transmission



Engineering Control Strategies

- **Ventilation & dilution**
  - Purging with cleaner outside (or recirculated) air
  - Increase air changes per hour
  - Pressurization control; isolation rooms

- **Air cleaning and disinfection solutions**
  - Filtration (MERV 13, HEPA filters)
  - Ultraviolet germicidal irradiation (UVGI)

Multi-Modal Approach Recommended

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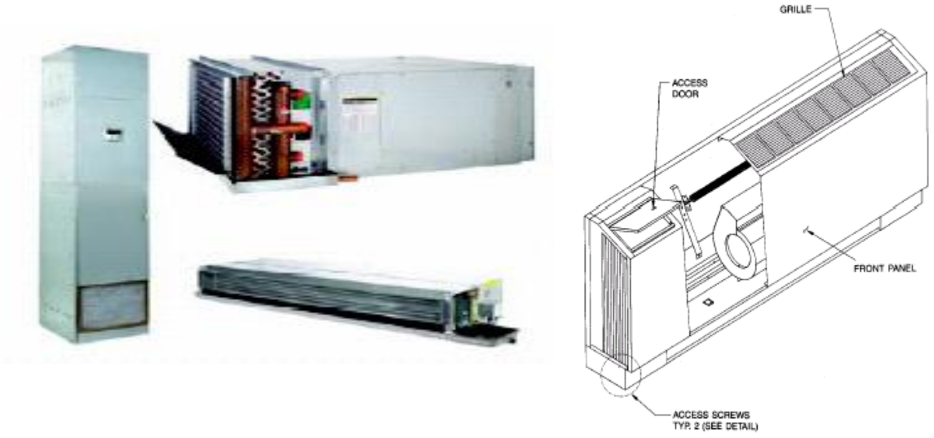
UV-C Applications In Buildings: HVAC

Indoor Air Handler

Outdoor Air Handler

Roof Top Air Handler



Fan Coil Units

UV-C Applications In Buildings

Coil Disinfection

Cooling Coil

Drain Pan

UVDI™

UV-C Applications In Buildings

Air Disinfection - Centralized HVAC System

Air Handling Unit (AHU)

Duct Mounted

UV-C Airstream Disinfection: Implementation Strategy

COMMON AIRBORNE MICROORGANISMS	
SARS-CoV-2, SARS, H1N1, MERs-CoV	
INFLUENZA (COMMON COLD)	
TUBERCULOSIS	MEASLES
MOLD SPORES	LEGIONELLA

Building Code And Standards

Clean Air Act

- Sets national ambient (i.e.: outdoor) air quality standards and regulates the levels of hazardous air pollutants

ASHRAE Ventilation Standard 62.1: Ventilation And Acceptable Indoor Air Quality

- Acceptable IAQ defined as “air in which there are no known contaminants at harmful concentrations, as determined by cognizant authorities, and with which a substantial majority (80% or more) of the people exposed do not express dissatisfaction.”
- Specifies minimum ventilation rates that yield an IAQ acceptable to human occupants while promoting energy efficiency.
- Ventilation rate for occupied spaces is based on area and prescribed occupant density

ASHRAE Ventilation Standard 62.2: Ventilation and Acceptable Indoor Air Quality In Residential Buildings

ASHRAE 170: Ventilation of Health Care Facilities: (Facility Guideline Institute (FGI) Guidelines)

ASHRAE Standard 241

New Pathogen Mitigation Standard

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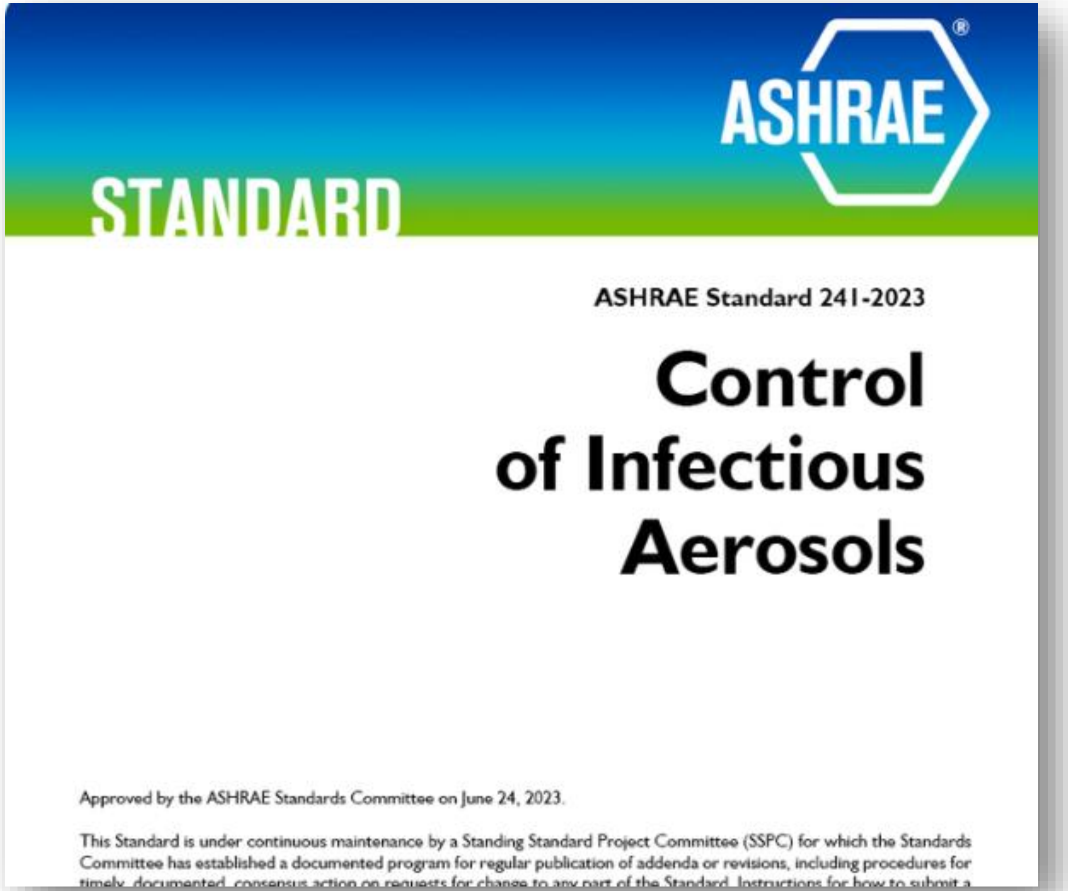
UV you can trust

ASHRAE Standard 241
Control Of Infectious Aerosols

Purpose

- Establish minimum requirements for control of infectious aerosols to reduce risk of disease transmission in occupiable space of new and existing buildings and major renovations (non-residential, residential, healthcare)



STANDARD

ASHRAE®

ASHRAE Standard 241-2023

Control of Infectious Aerosols

Approved by the ASHRAE Standards Committee on June 24, 2023.

This Standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for

ASHRAE Standard 241 | Key Highlights

- **Prerequisites:**
  - Systems should comply with requirements of ASHRAE 62.1, 62.2 and 170 standards

- **Infectious Risk Management Mode (IRMM):**
  Provides additional ventilation requirements during periods of elevated transmission risk.

- **Equivalent Clean Air flow rate (ECAi):**
  - A key feature of ASHRAE 241 is the introduction of new equivalent clean Airflow rates (ECA). ECA essentially refers to how quickly contaminated air is replaced by clean air. These rates are provided for different occupancy categories to control infectious aerosols

- **Filtration and Air Cleaning Technology:**
  - Equivalent clean air can be provided by the use of various filtration and air cleaning technologies (such as mechanical filters (HEPA), portable air cleaners, UV lights, photo-catalytic oxidation, ionizers etc.)

ASHRAE 241 vs. ASHRAE 62.1

- ASHRAE 241 increases the equivalent clean airflow requirement up to 10 times

Occupancy Category	ASHRAE 62.1 Outdoor Air Ventilation Rate (cfm)	ASHRAE 241 Equivalent Clean Airflow Rate (cfm)
Office	17	30
High School	13	40
Restaurant	10	60

ASHRAE Standard 241: Air Cleaning Systems Included

Air Cleaning

- In-Duct Air Cleaning Systems that Clean Air in the Air-Handling Ductwork, or Plenum
- In-Duct Air Cleaning Systems that Clean Air in the Occupied Zone
- In-Room Air Cleaning Systems
- Mechanical Fibrous Air Cleaning Systems

Pathogen Inactivation

- In-Duct Inactivation Systems
  - In-duct UVGI
  - Others

  (e.g. photocatalytic air cleaners)
- In-Room
  - Upper-Air UVGI
  - Ceiling mounted UV
  - Portable Air Cleaners

Summary

- MDROs continue to pose a steep challenge in healthcare facilities.
- UV device ability to inactivate MDROs should be supported by independent clinical evidence.
- Healthcare facilities face significant financial and labor challenges to implementing UV room disinfection
- Effective implementation starts with careful review of a device’s clinical, operational, financial characteristics prior to adoption
- Core device features (e.g.basic operation, safety features, mobility) and efficacy (e.g. room treatment times, number of placements) – play a key role in efficiency.
- “Off-device features” (e.g. assigning a program champion, using cloud-based data analytics, integration
- UV is a proven effective Air Disinfection and Air Purification technology and ideal for compliance with the ASHRAE 241 standard.

Questions?

Thank You For Your Attention

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